BACK-OFF RETRY WITH PRIORITY ROUTING

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority from the following U.S. patent applications and is a continuation-in-part of U.S. patent application Ser. No. 12/384,291 entitled, "METHOD FOR PROVIDING PATH FAILOVER FOR MULTIPLE SAS EXPANDERS OPERATING AS A SINGLE SAS EXPANDER", filed Apr. 2, 2009 now U.S. Pat. No. 8,077, 605;U.S. patent application Ser. No. 12/384,287 entitled, "SPECIFYING LANES FOR SAS WIDE PORT CONNEC-TIONS", filed Apr. 2, 2009 now U.S. Pat. No. 7,913,023; U.S. patent application Ser. No. 12/384,288 entitled, "SAS PAIRED SUBTRACTIVE ROUTING", filed Apr. 2, 2009 now U.S. Pat. No. 8,321,596; and U.S. patent application Ser. No. 12/791,244 entitled, "ALLEVIATING BLOCKING CASES IN A SAS SWITCH", filed Jun. 1, 2010.

Additionally, U.S. patent application Ser. No. 12/791,244 entitled, "ALLEVIATING BLOCKING CASES IN A SAS SWITCH", filed Jun. 1, 2010, now U.S. Pat. No. 8,244,948 claims priority from and is a continuation-in-part of U.S. patent application Ser. No. 12/384,289 entitled, "COMBIN-ING MULTIPLE SAS EXPANDERS TO PROVIDE SINGLE SAS EXPANDER FUNCTIONALITY," now issued U.S. Pat. No. 7,849,248.

Further, U.S. patent application Ser. No. 12/384,289 entitled, "COMBINING MULTIPLE SAS EXPANDERS TO PROVIDE SINGLE SAS EXPANDER FUNCTIONALITY," now issued U.S. Pat. No. 7,849,248, filed Apr. 2, 2009; U.S. patent application Ser. No. 12/384,291 entitled, "METHOD FOR PROVIDING PATH FAILOVER FOR MULTIPLE SAS EXPANDERS OPERATING AS A SINGLE SAS EXPANDER", filed Apr. 2, 2009; U.S. patent application Ser. No. 12/384,287 entitled, "SPECIFYING LANES FOR SAS WIDE PORT CONNECTIONS", filed Apr. 2, 2009; and U.S. patent application Ser. No. 12/384,288 entitled, "SAS PAIRED SUBTRACTIVE ROUTING", filed Apr. 2, 2009 claim the benefit under 35 U.S.C. §119(e) of U.S. Provisional Application Ser. No. 61/191,037, filed Sep. 5, 2008.

In addition, the present application incorporates by refer-ence all of the above applications.

TECHNICAL FIELD

The present disclosure generally relates to the field of Serial Attached SCSI (SAS), and more particularly to a back-off retry process implemented in a single, cohesive SAS expander context.

BACKGROUND

Serial Attached SCSI (SAS) is a term referring to various technologies designed to implement data transfer between computer devices. The SAS protocol is a serial successor to the parallel Small Computer System Interface. In the SAS protocol, all SAS devices are either an initiator device, a target device, or an expander device. Initiator devices are devices that begin an SAS data transfer, while target devices are the devices to which initiator devices transfer data. Together, initiator devices and target devices are known as end devices.

SAS expanders are devices that facilitate data transfer between multiple initiator devices and multiple target devices. The SAS protocol utilizes a point-to-point bus topol-

ogy. Therefore, if an initiator device is required to connect to multiple target devices, a direct connection must be made between the initiator device and each individual target device in order to facilitate each individual data transfer between the initiator device and each individual target device. SAS expanders manage the connections and data transfer between multiple initiator devices and multiple target devices. SAS expanders may contain SAS devices.

SUMMARY

In one aspect, a method for back-off retry in a single, cohesive SAS expander may include, but is not limited to, routing a data transfer between an input of a single, cohesive SAS expander and an output of the single, cohesive SAS expander, wherein the single, cohesive expander includes a first SAS expander, and at least one additional SAS expander, wherein the first SAS expander is connected to the at least one additional SAS expander via at least one inter-expander link (IEL) for inter-expander communications, determining link availability between the first SAS expander and a port of a device, then, upon determination of a failed link or a busy link between the first SAS expander and the port of the device, re-routing the data transfer of the first SAS expander to a second SAS expander. The method further includes determin-ing link availability between the second SAS expander and the port of the device, and, upon determination of a failed link or a busy link between the second SAS expander and the port of the device, re-routing the data transfer from the second SAS expander to the first SAS expander or a third SAS expander, or retrying the data transfer through the second SAS expander.

In another aspect, a method for back-off retry with priority routing in a single, cohesive expander may include, but is not limited to, routing a data transfer between an input of a single, cohesive SAS expander and an output of the single, cohesive SAS expander. The routing of data further includes routing a first OPEN request on a direct path through a first SAS expander to a port of a device while routing a second OPEN request on an alternate path from the first SAS expander and through a second SAS expander to the port of the device. The method further includes determining link availability between the second SAS expander and the port of the device, and, upon determination of a failed link or a busy link, re-routing the data transfer from the second SAS expander to the first SAS expander or a third SAS expander, or retrying the data transfer through the second SAS expander.

It is to be understood that both the foregoing general description and the following detailed description are exem-plary and explanatory only and are not necessarily restrictive of the present disclosure. The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate subject matter of the disclosure. Together, the descriptions and the drawings serve to explain the principles of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The numerous advantages of the disclosure may be better understood by those skilled in the art by reference to the accompanying figures in which:

FIG. 1 is a block diagram illustrating a SAS topology illustrating a single, cohesive SAS expander;

FIGS. 2A through 2E are block diagrams illustrating vari-ous configurations of a single, cohesive SAS expander;

FIG. 3 is block diagram illustrating a blade center switch configuration of a single, cohesive SAS expander;